

DIVISION 3
CONCRETE

SECTION 03000
CONCRETE WORK

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Furnish all labor, materials, and equipment required for proportioning, mixing, transporting and placing Portland Cement concrete as required for the project.
- B. Provide protection of placed concrete from vandalism, wind, temperature extremes, and loss of moisture.

1.02 RELATED WORK AND REFERENCES

- A. Section 03050 - Concrete Curb, Gutter, Sidewalk, and Drive Approaches
- B. Section 03100 - Concrete Formwork
- C. Section 03200 - Concrete Reinforcement
- D. Section 03250 - Concrete Curing Compound
- E. Section 03300 - Cast-In-Place Concrete
- F. Section 03450 - Structural Precast Concrete
- G. Section 05000 - Material Testing
- H. ACI 301 - Specifications for Structural Concrete

PART 2 PRODUCTS

2.01 MATERIALS

- A. All concrete used in Sandy City shall be AA(AE) meeting mix design as shown on Table 03000 - 1.

TABLE 03000-1							
CLASS	Coarse Aggregate Size (inches)	Maximum Water/Cement Ratio (By wgt.)	Minimum Cement Content (Sacks/C.Y.)	Slump (inches)	Air Content Percent	Mix Design Compress (PSI)	28 Day Minimum Compressive (PSI) Strength)
AA(AE)	1" to No.4	0.44	6.5	1-3.5	5.0-7.5	5210	3650

- B. Concrete Reinforcement: Refer to Section 03200.
- C. Concrete Curing Compound: Refer to Section 03250.
- D. Material Testing: Refer to Section 05000.
- E. Concrete Formwork: Refer to Section 03100.
- F. Structural Precast Concrete: Refer to Section 03450.

- G. Cast-In-Place Concrete: Refer to Section 03300.

2.02 PROPORTIONING

- A. Unless specified otherwise, replace 20 percent of the Portland cement by weight with Class F fly ash from a source on the UDOT Materials Quality Assurance list.
- B. For architectural concrete maintain designated colors and uniformity. For concrete of a desired color, use same mixture proportions throughout. Do not change the quantity of cement per cubic yard.
- C. Use only one type and brand of cement from the same mill, one source and maximum size of coarse aggregate, one source of fine aggregate, and one placing consistency.
- D. In proportioning materials for mixing, use certified scales. Do not use volume measurements except for water and liquid admixtures.

2.03 BATCHING MATERIALS

- A. Refer to UDOT Section 505.3.4.

2.04 MIXING

- A. Mix in a batch mixer of approved type and capacity. Mix for not less than one minute after all materials are in the drum for mixers of one cubic yard or less capacity. For dual drum and single drum mixers of more than one cubic yard capacity the minimum mixing time is 45 seconds. Operate the mixer at the drum speed recommended by the manufacturer. Replace pick-up and throw-over blades when they are worn down 3/4 inch or more. Keep drums and blades free of excessive build-up of cement and mortar.
- B. Use water measuring devices that are accurate to within one percent by weight and not affected by variations in line pressure or construction conditions.
- C. Charge the batch materials into the mixer so that a portion of the mix water will enter the drum in advance of the cement and aggregates and continue to add water for at least five seconds after all other materials are in the drum. Add air-entraining agents and other approved liquid admixtures to the water before it enters the mixer by means of an automatic dispenser capable of accurately metering the materials.

When two admixtures are used in the concrete, add to the water in such a manner that the two admixtures will not be in contact prior to entering the mixing drum.

- D. After the concrete leaves the batch plant, additional water may be added only with the approval of the Engineer. However, the amount of water added cannot exceed the maximum allowed on the batch ticket to exceed the water-cement ratio. Add water when the drum is rotating and continue to rotate the drum at least 30 revolutions at the mixing speed recommended by the manufacturer. Do not add water after more than 1/2 cubic yard of concrete has been discharged from the drum.
- E. Mix concrete only in such quantities as is required for immediate use. The maximum allowable time between charging of the material in the mixing drum and final placing is 90 minutes for air temperatures below 80° F. and 60 minutes when the air temperature is above 80° F. Do not use concrete not placed within these time limits or if an initial set has developed.
- F. Provide batch certification ticket that includes the following information:
1. Name of ready-mix batch plant.
 2. Serial number of ticket.
 3. Date and truck number.
 4. Name of contractor.
 5. Specific designation of job (name and location).
 6. Volume of concrete.
 7. Time loaded or of first mixing of cement and aggregates.
 8. Signature or initials of ready-mix representative.
 9. Type and brand of cement.
 10. Amount of cement (number-of-bag mix).

11. Total water content by producer or W/C ratio.
 12. Water added by receiver of concrete and his initials.
 13. Admixtures and amount of same.
 14. Maximum size of aggregate.
 15. Indication that all ingredients are as previously certified or approved.
- G. Use only transit mixers that are equipped with a water meter and revolution counter. The water meter is to measure all water discharged from the truck's water tank.
- H. If air content is low the contractor shall not be allowed to remix at a speed exceeding 17 revolutions per minute.

2.05 HAND MIXING

- A. Hand mixing must be pre-approved by Engineer.
- B. Do not hand mix batches exceeding 0.5 cubic yards in volume.
- C. Hand mix only on a watertight platform. Spread the fine aggregate evenly on the platform and mix in the cement thoroughly while dry and until the mixture is of a uniform color. Add the water and turn the entire mass until all the stones are thoroughly covered with mortar and the mixture is of uniform color and consistency.

2.06 HEATING WATER & AGGREGATE

- A. If heated aggregates are required because of cold weather operation, provide and operate suitable heating devices with no additional compensation. Heat the aggregates either by steam or dry heat. Do not allow the products of combustion of any fuel to contact the aggregate. Heat the aggregates and mixing water to a temperature not more than 150° F. when mixed. Regardless of the heating method used, heat the aggregates uniformly and avoid overheating or the development of "hot spots". Maintain the temperature of the mixed concrete at the time of placing between 60° F. and 90° F.
- B. If water or aggregate is heated above 100° F., combine the water with the aggregate in the mixer before the cement is added. Do not mix cement with water or with mixtures of water and aggregate having temperature greater than 90° F.
- C. Refer to ACI 306 for recommendations to heat water and aggregate during cold weather.

PART 3 EXECUTION

3.01 PLACEMENT

Place the concrete as required for its intended use and in accordance to the requirements of Section 03300.

3.02 COLD WEATHER PLACEMENT

- A. Cold weather placement limitations are applicable when the air temperature is forecasted to fall below 40° F any time within 7 calendar days of placement. When air temperature is below 40° F:
1. Provide for approval by the Engineer a cold weather placement plan that includes the necessary equipment and materials (to include heating of water and aggregate as specified in 2.06 of this Section) to maintain the concrete at 50° F for at least seven days.
 2. Placement may begin when the surface (base material) temperature is 36° F and rising. Do not place any concrete on frozen materials.
- B. Cold Weather: ACI 306. Unless allowed otherwise by Engineer, increase the cement content in the mix design by 1 bag between October 1 and April 1 (i.e. Minimum Cement Content of 7.5 Sacks/CY).
- C. Do not use chemical additives in the concrete to prevent freezing.
- D. Calcium Chloride is not an acceptable accelerator. The use of other accelerators shall be approved by the Engineer.

3.03 HOT WEATHER PLACEMENT

- A. Maintain the temperature of the aggregate and water so that the concrete mix temperature is below 90° F.
- B. Wet forms, reinforcing steel, and the supporting earth immediately prior to placing concrete.
- C. After the concrete is in the forms in vertical walls and columns, intermittently sprinkle the forms with water to reduce the temperature of the concrete and forms.
- D. Comply with ACI-305, Hot Weather Concreting.
- E. No concrete shall be placed when air temperature is over 95° F.

3.04 CURING OF CONCRETE

- A. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration and hardening of concrete. Materials and methods of curing subject to approval.
- B. To preserve moisture in unformed concrete surfaces, apply one of the following immediately after placement and finishing.
 - 1. Ponding or continuous sprinkling
 - 2. Absorptive mats or fabric kept continuously wet.
 - 3. Sand kept continuously wet
 - 4. Continuous mist spray.
 - 5. Waterproof sheet materials, ASTM C 171.
 - 6. Other moisture-retaining covering as approved.
 - 7. Curing compound as per Section 03250.
- C. Minimize moisture loss from formed surfaces exposed to heating by sun by keeping forms wet. After form removal, cure concrete as per Section 03250.
- D. When mean daily outdoor temperature is less than 40° F., maintain temperature of concrete between 50° and 60° F. for required curing period. When necessary, make arrangements for heating, covering, insulating, or housing to maintain required temperature. Do not use combustion heaters during first 24 hours unless precautions are taken to prevent exposure of concrete to carbon dioxide and loss of moisture.
- E. When necessary, make provisions for windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material. Take such protective measures as quickly as concrete hardening and finishing operations will allow.
- F. Keep air temperature immediately adjacent to concrete during and immediately following curing period as uniform as possible. Do not allow change exceeding 5°F per hour or 50°F. per 24 hours.
- G. During curing period, protect concrete from being damaged by mechanical disturbances such as load stresses, heavy shock, and excessive vibration.

3.05 PROTECTION

- A. Protect concrete work against injury from elements and defacement of any nature, including staining and vandalism, during construction operations.
- B. Do not walk on slabs or in any way disturb, except as required by the work, until they have set for at least 24 hours at a temperature of not less than 60° F. or a longer time where necessary at a lower temperature to obtain a hard set. Do not allow general traffic on concrete surfaces for a period of seven days after concrete has been placed.

- C. Do not permit concrete to freeze. Protect by enclosing, covering, and applying adequate heat so that continuous setting and curing will occur as previously discussed.
- D. Protect concrete slabs from damage by oil, grease, and other harmful material. Cover work areas with a suitable material laid over dry concrete.
- E. Remove and replace any damaged concrete as directed by the Engineer as per Section 03050.

3.06 QUALITY

- A. Perform work in accordance with ACI 301.
- B. Comply with Section 05000 "Material Testing".
- C. Strength:
 - 1. The strength of the concrete in-place will be considered potentially deficient if it fails to comply with any of the following requirements or any other which control the strength of the structure:
 - a. Low concrete strength.
 - b. Reinforcing steel size, quantity, strength, position, damage, or arrangement varies from requirements of Section 03200.
 - c. Concrete which differs from required dimensions or location in such a manner as to reduce its strength or load carrying capacity.
 - d. Method of curing not as specified.
 - e. Inadequate protection of concrete from extremes of temperature during the early stages of hardening and strength development.
 - f. Mechanical injury, construction fires, accidents, or premature removal of formwork likely to result in deficient strength or load carrying capacity.
 - g. Workmanship likely to result in deficient strength.
 - 2. Structural analysis and/or additional testing may be required at the expense of the contractor when the strength of concrete is considered potentially deficient.
 - 3. All structurally deficient concrete will be replaced by the contractor as directed by Engineer at no cost to the City.
- E. Tolerances - Refer to Section 03050, 3.03.

END OF SECTION

SECTION 03050

CONCRETE CURB, GUTTER, SIDEWALK, AND DRIVE APPROACHES

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Furnish all labor, materials, and equipment as required to furnish, place, and finish Portland cement concrete to the lines, grades, thicknesses, and cross-sections listed on the plans for sidewalk, ramps, aprons, curb, gutter, and driveways.

1.02 RELATED WORK AND REFERENCES

- A. Section 02220 - Excavation
- B. Section 02230 - Granular Materials, Flowable Fill, Top Soil
- C. Section 02503 - Bituminous Paving Course
- D. Section 03000 - Concrete Work
- E. Section 03100 - Concrete Formwork
- F. Section 03200 - Concrete Reinforcement
- G. Section 03250 - Concrete Curing Compound
- H. Section 03300 - Cast-In-Place Concrete
- I. Section 05000 - Material Testing
- J. Sandy City Development Code
- K. Sandy City Standard Details CD-01, CD-02, CD-03, CG-02, IC-01, CG-01, and MS-01

1.03 QUALITY ASSURANCE

- A. Comply with all pertinent codes, regulations, and standards.
- B. Notify Sandy City Public Works Department 48 hours prior to concrete placement for inspection scheduling.

1.04 JOB CONDITION

- A. Examine surface scheduled to receive concrete for:
 - 1. Defects that will adversely affect the execution of the work.
 - 2. Deviations beyond allowable tolerances for installation of sub-base material.
 - 3. Soft and yielding spots and/or poor load bearing soils.
- B. Do not start work until unsatisfactory conditions are corrected.

1.05 DEFINITIONS

- A. "Open Driveway Approach" is as shown on the standard detail (CD-03) consisting of the concrete sidewalk, the concrete apron, including the curved curb transition to the curb and gutter line and the modified curb and gutter adjacent to the driveway apron.
- B. "Flared Driveway Approach" is as shown on the standard details (CD-01, CD-02) consisting of the concrete sidewalk, the concrete apron, including the funnel transition to the curb and gutter line and the modified curb and gutter adjacent to the driveway apron.

1.06 **NO NEW CURB AND GUTTER CONSTRUCTION WITH LESS THAN 0.50% GRADE**

ALLOWED UNDER ANY CIRCUMSTANCES FOR NEW CONSTRUCTION. GRADES LESS THAN 0.50% FOR RECONSTRUCTION/REDEVELOPMENT MUST BE APPROVED BY ENGINEER.

1.07 SPECIAL REQUIREMENTS FOR CURB AND GUTTER

- A. Scarify and re-compact top six inches of subgrade to an average of 96 percent of maximum dry density.
- B. The Contractor will supply acceptance testing from an independent testing laboratory on compaction before concrete is placed.
- C. Set grade control by one of the following methods:
 - 1. If a string line is used, set grade stakes at a maximum of twenty-five (25) feet on center.
 - 2. If a laser is used, set grade stakes at each break in grade.
 - 3. Provide additional control to ensure forms are placed such that gravity flow will be obtained.
- D. Set grade stakes and forms to within .01 feet of true grade at any given spot.
- E. Obtain Engineer's approval of forms before placing concrete.
- F. Engineer will check concrete after forms are removed. Remove and replace sections with deviations from true grade of more than .01 feet.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Comply with Section 02230 for untreated base course.
- B. Forms and Formwork: Comply with Section 03100 - "Concrete Formwork".
- C. For Expansion and Contraction Joints, Joint Sealant, and Curing compound, see Section 03250.
- D. Concrete Reinforcement: In conformance with section 03200 - "Concrete Reinforcement".
- E. Patching: Utilize UDOT approved materials. Sikatop 123 or approved equal.

2.02 MIX

Mix for Portland Cement Concrete: Comply with Section 03000, 2.01.

PART 3 EXECUTION

3.01 PREPARATION

- A. Survey curb and gutter grades to verify drainage. Check each side of work being done to ensure drainage. Contact the Engineer if any drainage problems exist before pouring concrete. Failure to check and verify will result in contractor having to repair at own expense any drainage problems.
- B. Expose subgrade to true line and grade. Scarify subgrade a minimum of six (6) inches below untreated base course. Remove any soft or spongy material to a depth as specified by Engineer and replace with untreated base course. Compact subgrade to 96% density as determined in accordance with Section 02240, part 3.
- C. Unless specified otherwise, provide six (6) inches minimum of 3/4" untreated base course below curbs, gutters, residential driveways, and alley intersections. Install four (4) inches below sidewalks. Compact base course to 96% density as determined in conformance with Section 02240, part 3. Extend the untreated base course a minimum

of six inches beyond the back of the curb.

- D. Drainage Outlet through Curb: Curb outlet drains are prohibited unless prior written approval is obtained from Engineer.
- E. Saw cut as detailed by Engineer conforming with applicable standard detail and providing a straight line, full depth saw cut at score marks.
- F. Utilize signs, barricades, flag persons or any other equipment and personnel to make safe construction areas within any city right-of-way, in conformance with the current MUTCD.
- G. Use of gandy and sprinkling of water for finishing purpose is prohibited. Power screeds may be used to move concrete short distances, but not for consolidation.

3.02 FIELD QUALITY CONTROL

Refer to Section 05000 for testing.

3.03 QUALITATIVE SPECIFICATIONS

- A. Curb, Gutter, and Waterways will be rejected for any of the following reasons:
 - 1. Line: More than ½ inch in 10 feet and more than 1 inch from true alignment at any location.
 - 2. Grade: More than 1/4 inch plus or minus deviation from true grade in 10 feet.
 - 3. Ponding: More than 6 inches in a horizontal direction or more than 1/4 inch deep.
 - 4. Cracks: Any continuous crack through the entire exposed section.
 - 5. Scratches: More than 1/4 inch deep.
 - 6. Chips: More than 2 inches into an exposed surface and more than 8 square inches per section.
 - 7. "Spalling or Scaling": More than 4 large aggregates are exposed on the surface per 10 foot section.
 - 8. "Honeycombing": More than 2 continuous feet and 1 inch depth per 10 foot section on formed surfaces.
 - 9. "Spiderweb" or "Map" Cracking: More than 25% of exposed surface per section.
 - 10. Standard Cross Section Dimension: More than 1/4 inch plus or minus deviation from the standard drawing dimensions.
 - 11. Graffiti and/or vandalism.
- B. Sidewalks will be rejected for any of the following reasons:
 - 1. For any of the reasons in 3.03, A, 1-9, above.
 - 2. Standard Cross Section Dimension: More than 1/4 inch from the standard drawing dimensions.
 - 3. Cross Slope: Plus or minus 0.5% falling towards the street and as shown on drawings.
- C. Drive approaches will be rejected for any of the following reasons:
 - 1. Same as 3.03, A, 1-10.
 - 2. Comply with standard detail tolerances.

3.04 INSTALLATION

- A. Place and consolidate Portland Cement concrete as per Section 03300.
- B. Backfilling behind Curb and Gutter: After the concrete has been cured for 72 hours, backfill behind the curb with a material approved by the Engineer. Backfill to within two inches of the top of the curb or gutter and for a distance of (5) five feet out from the back of the curb or as directed by the Engineer.
- C. Placing operations may be postponed when, in the opinion of the Engineer, impending weather conditions may impair the quality of the finished work. In case rainfall should occur after placing operations are started, the Contractor shall provide ample covering to protect the work.
- D. Score Lines:
 - 1. Make scoring lines a minimum depth of $\frac{1}{2}$ inch and a radius of $\frac{1}{8}$ inch. Make longitudinal scoring lines parallel to, or concentric with, the lines of the work.
 - 2. In walk returns install scoring lines as directed by Engineer.
 - 3. Place score lines at intervals equal to the width of the sidewalk.
 - 4. Score lines shall be placed straight by using a straight edge as a guide.
- E. Construction Joints:
 - 1. Place joints perpendicular to the subgrade and at right angles to the longitudinal axis of the sidewalk, median, curb or integral curb and gutter.
 - 2. In walks, install joints transverse to the line of work and at regular intervals not exceeding 12 feet. At curb and walk returns make the joints radial.
 - 3. In gutter, including gutter integral with curb, install $\frac{1}{8}$ to $\frac{3}{16}$ inch steel template joints at regular intervals of ten feet. Where integral curb and gutter is adjacent to concrete pavement, align the joints with the pavement joints where practical. Cut the joints $1\frac{1}{2}$ inches deep when using the slip form method to place the concrete.
- F. Weakened Plane Joints (Contraction Joints):
 - 1. Make contraction joints straight unless otherwise shown on the plans.
 - 2. Make the finished joint $\frac{1}{4}$ slab thickness deep with a radius and width of $\frac{1}{2}$ inch.
- G. Expansion Joints:
 - 1. For curbs and gutters install expansion joints at intervals not to exceed 50 linear feet or 150' for slip-form placement, all PCs, Pts and construction joints.
 - 2. For walks install expansion joints at intervals not to exceed 48 feet for four foot walks, 50 feet for five foot walks, and 54 feet for six foot walks. Spacing for larger walks to be approved by Engineer.
 - 3. Place expansion joint filler, $\frac{1}{2}$ " inch thick, in walk at the PC and PT of all walk returns, around all utility poles which may project into the concrete along the line of work, around hydrants and manhole frames, walls, and between sidewalk and buildings abutting said sidewalk. Install joint filler strips the depth of the concrete plus one inch, with the top set flush with the specified grade of the top of the concrete.
 - 4. Construct $\frac{1}{2}$ inch joints in curb and gutter at the end of all returns, except where waterway transitions extend beyond the curb return; in which case place them at the ends of the drain gutter transition. Construct no joints in curb returns. Where monolithic curb and gutter is constructed, place expansion joint at PC and PT of curb returns.
 - 5. Do not construct expansion joints in waterways, alley intersections, drive approaches or driveway, except as may be approved by the Engineer.

6. Where sidewalk is being replaced, saw cut and join the walk to the nearest joint of the existing improvements. If existing adjacent concrete slabs not scheduled for replacement are damaged by the contractor's operation, replace the concrete to the next joint at no cost to the City.
- H. Pedestrian Ramps: Access ramps shall be placed at all corners and at all driveways where the sidewalk is not continuous. Finish with a broomed finish and detectable warning system as required. Construct access ramps in conformance with Standard Detail IC-01.
- I. Driveway Approaches:
 1. Provide driveway approaches in new curb at locations shown on the plans, and at such other locations as may be designated by the Engineer.
 2. Construct driveway approaches as per detail CD-01, CD-02 and CD-03.
 3. The minimum and maximum width of driveway approaches shall comply with table of driveway dimensions, Standard Detail, CD-01, CD-02 and CD-03.
 4. Flared drive approaches (Standard Detail CD-01) shall be installed on all residential driveways unless otherwise approved by Engineer.

3.05 CLEANING

- A. Complete backfilling to the finished surface of the newly constructed improvement or as indicated on the project drawings.
- B. Upon completion of the work, clean the surface of the concrete and leave the site in a neat and orderly condition.

END OF SECTION

SECTION 03100
CONCRETE FORMWORK

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Furnish all labor, material, and equipment as required for forming cast-in-place concrete, including necessary shoring, bracing, and anchorage.
- B. Construct openings in formwork as required for other related work.
- C. Provide and install all form accessories such as snap ties, bracing, etc.
- D. Stripping of forms from finished concrete.

1.02 RELATED WORK AND REFERENCES

- A. Section 03000 - Concrete Work
- B. Section 03050 - Concrete Curb, Gutter, Sidewalk and Drive Approaches
- C. Section 03200 - Concrete Reinforcement
- D. Section 03250 - Concrete Curing Compounds
- E. Section 03300 - Cast-In-Place Concrete
- F. Section 03450 - Structural Precast Concrete

1.03 QUALITY ASSURANCE

- A. When required in the contract, submit three copies of detailed falsework drawings (prepared by a licensed engineer) for approval at least three weeks before construction starts. Use AASHTO Division II Section 3 (Temporary Work) for minimum design criteria.
- B. Design and Construct Forms:
 - 1. Using materials able to sustain the stresses resulting from the placement of concrete and construction loads while maintaining the specified tolerances in Section 03000.
 - 2. With sufficient strength to support loads, lateral pressure, and allowable stresses outlined in ACI 347 and for design considerations such as wind loads, allowable stresses, and other applicable requirements of controlling local building code.
 - 3. To permit easy removal
 - 4. Clean the inside surface of forms of all dirt, mortar and foreign material before concrete placement.
- C. The design, engineering, and construction of formwork is the responsibility of contractor.

1.04 JOB CONDITIONS

- A. Establish and maintain sufficient control points and bench marks for reference purposes to check tolerances. Maintain in an undisturbed condition until final completion and acceptance of project.
- B. Allow no portion of work to extend beyond project boundaries.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Smooth Forms: Faced with material which will produce smooth, hard, uniform texture on concrete.
 - 1. Arrange facing material orderly and symmetrical, keeping number of seams to a practical minimum.
 - 2. Use mortar-tight concrete forms true to the dimensions, lines, and grades of the structures, and of sufficient strength to prevent deflection during the placement of concrete.
 - 3. Discontinue using any form or forming system that produces a concrete surface with excessive undulations until modifications have been made. Undulations are excessive if they exceed either 3/32 inches or 1/270 of the center-to-center distance between studs, joints, forms, fasteners, or wales.
 - 4. Countersink all bolt and rivet holes when using metal forms for exposed surfaces so that a plane, smooth surface of the desired contour is obtained.
 - 5. Lumber is to be free of knotholes, loose knots, cracks, splits, warps, or other defects that affect the strength or appearance of the structure. Rough lumber may be used for forming surfaces if rough surfaces do not show on the final structure.
 - 6. Form all exposed surfaces of each element of a concrete structure with the same forming material or with such materials that produce a concrete surface that is uniform in texture, color, and appearance.
- B. Form accessories that are to be partially or wholly embedded in concrete are to be a commercially manufactured type.
 - 1. Do not use non-commercially fabricated wire.
 - 2. Use form ties constructed so that ends or end fasteners can be removed without causing appreciable spalling of concrete faces.
 - 3. After ends or end fasteners of form ties have been removed, embedded portion of ties are not to terminate less than two bar diameters from formed faces of concrete and in no case less than 3/4 inches.
 - 4. When formed face of concrete is not to be permanently exposed to view, form ties may be cut off flush with formed surfaces. Use ties with 3/4 inch diameter cones on both ends for water retaining structures.
- C. Pre-molded Expansion Joint Filler: Comply with Section 03250, 2.06.
- D. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.
- E. Fillets for Chamfered Corners: Wood strips 1 X 1 inch size; using maximum possible length.
- F. Construct drainage and weep holes as follows:
 - 1. Construct drainage and weep holes at locations indicated on the plans or as directed.
 - 2. Place ports or vents for equalizing hydrostatic pressure below low water level.
 - 3. Use non-corrosive materials for weep hole forms.
 - 4. Remove forms after the concrete is placed.
 - 5. Paint exposed surfaces of metal drains as indicated on the plans.

PART 3 EXECUTION

3.01 INSPECTION

- A. Verify lines, levels, and measurements before proceeding with formwork.
- B. Do not place concrete in the forms until:
 - 1. All work connected with form construction has been completed.
 - 2. All embedded materials have been placed.
 - 3. All dirt, chips, sawdust, standing water, and other foreign material have been removed.
 - 4. Inspection and approval have been obtained.

3.02 CONSTRUCTION

- A. Make forms sufficiently tight to prevent loss of concrete.
- B. Place chamfer strips in corners of forms to produce beveled edges on permanently exposed surfaces. Interior corners on such surfaces and edges of formed joints will not require beveling.
- C. Maintain specified finish tolerances, chamfer formwork to compensate for anticipated deflections.
- D. Provide positive means of adjustment using wedges or jacks, or shores and struts, and take up all settlement during concrete placing operation.
- E. Securely brace forms against lateral deflection.
- F. Provide temporary ports in formwork to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain. Close ports with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be apparent in exposed concrete surfaces.
- G. At construction joints, overlap forms over hardened concrete at least six inches. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain true surface.
- H. Construct forms for wall openings to facilitate loosening, if necessary, to counteract swelling.
- I. Fasten wedges, used for final adjustment of forms prior to concrete placement, in position after final check.
- J. Anchor formwork to shores or other supporting surfaces or members so that upward or lateral movement of any part of formwork system is prevented during concrete placement.
- K. Provide runways with struts or legs for moving equipment, supported directly on formwork or structural member without resting on reinforcing steel.
- L. Position expansion joint material and other embedded items accurately and support against displacement.
- M. To prevent entry of concrete, fill voids in sleeves, inserts, and anchor slots temporarily with readily removable material.
- N. For architectural concrete, limit deflection of facing materials between studs as well as deflection of studs and walers to 0.0025 times span.
- O. Do no de-water by pumping during placement of concrete, or for 24 hours thereafter, unless pumping is outside the enclosure. Do not use well points to dewater footing.

3.03 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for work embedded in or passing through concrete.

- B. Coordinate work of other sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.
- C. Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.

3.04 FORM FINISHES

- A. Comply with Section 03300, 3.10.

3.05 FORM COATING

- A. Before placement of reinforcing steel or concrete, cover surfaces of forms with form coating, unless factory applied non-absorptive liner is used or unless otherwise specified or approved by the Engineer.
 - 1. Do not allow excess form coating material to stand in puddles in forms nor in contact with hardened concrete against which fresh concrete is to be placed.
 - 2. Remove and replace from the forms and from the site all reinforcing steel that is contaminated with oil, hardened concrete or any other substance which would inhibit bond of fresh concrete to the reinforcing steel.

3.06 REMOVAL OF FORMS

- A. Do not pry against face of concrete. Use only wooden wedges.
- B. When repair of surface defects or finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations.
- C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging. Perform needed repairs or treatment required on such sloping surfaces immediately after form removal, followed by specified curing.
- D. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete.
- E. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.
- F. Where no re-shoring is planned, leave forms and shoring used to support weight of concrete in beams, slabs, and other concrete members in place until concrete has attained its specified strength (f_c).
- G. Where re-shoring is planned, supporting formwork may be removed when concrete has reached 75 percent of specified strength, provided re-shoring is installed immediately.
- H. When shores and other vertical supports are so arranged that non-load carrying, form-facing material may be removed without loosening or disturbing shores and supports, facing material may be removed at an earlier age as permitted.

3.07 REUSE OF FORMS

- A. Do not reuse forms if there is any evidence of surface wear or defect which would impair quality of surface.
- B. Thoroughly clean and properly coat forms before reuse.

3.08 FIELD QUALITY CONTROL

- A. Observe formwork continuously while concrete is being placed to see that there are no deviations from desired elevation, alignment, plumbness, or camber.
- B. If during construction any weakness develops and falsework shows undue settlement or discoloration, stop work, remove affected construction if permanently damaged, and strengthen false work.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Provide all labor, materials, and equipment as required to furnish and place reinforcing steel in accordance with the plans, specifications, and the directions of the Engineer.
- B. Furnish and place support chairs, bolsters, bar supports, and spacers for supporting reinforcement.

1.02 RELATED WORK AND REFERENCES

- A. Section 03000 - Concrete Work
- B. Section 03100 - Concrete Formwork
- C. Section 03250 - Concrete Curing Compound
- D. Section 03300 - Cast-In-Place Concrete
- E. Section 03450 - Structural Precast Concrete

1.03 QUALITY ASSURANCE

- A. Fabricate to tolerances specified in Section 03300.
- B. For details of reinforcement and accessories not indicated, comply with the requirements of ACI 315.
- C. Accurately bend all bars. Field bending only as approved by Engineer .
- D. Inspected and approved placing and securing of reinforcement in each section of the work approved before any concrete is placed.
- E. Do not damage the bars or the coating during handling and storage.
 - 1. Use systems with padded contact areas when handling coated bars.
 - 2. Pad all bundling bands
 - 3. Lift all bundles with strong-back, multiple supports, or a platform bridge.
 - 4. Do not drop or drag bars.
 - 5. Stockpile or store reinforcing steel on timbers or where contaminates will not damage or be injurious.
- F. Repair damaged bars or coating at no additional cost to the City. Have the coated bars inspected for damage to the coating after the bars are in place and immediately before concrete placement. Repair all visible defects using the specified patching or repair material.

1.04 SHOP DRAWINGS

- A. Submit shop drawings as required by Engineer.
- B. Indicate sizes, spacing, locations, and quantities of reinforcing steel and wire fabric. Provide bending and cutting schedules. Provide splicing and stirrup spacing, as well as supporting and spacing device locations.
- C. Prepare shop drawings under seal of professional engineer registered in the State of Utah as required.

1.05 CERTIFICATES

As required by Engineer, submit mill test certificates of supplied concrete reinforcing indicating physical and chemical analysis.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Reinforcing Steel: ASTM A 615, grade 40 or 60 yield grade billet steel deformed bars including supplementary requirements S1, uncoated as shown on the plans. When no grade is given use 60 grade steel.
- B. Welded Steel Wire Reinforcement: ASTM A 185 plain type; in flat sheets or coiled rolls uncoated finish as shown on the plans.
- C. Stirrup Steel: ASTM A 82
- D. Smooth dowel bars for construction joints: ASTM A 29, Grade 60.
 - 1. Where indicated, provide metal dowel cap at one end of dowel to permit longitudinal movement of dowel within concrete section.
 - 2. Provide for movement which equals joint width plus one-half inch.
- E. Mechanical Butt Splices: Erico Products Co., Cadweld 125 percent yield point splices or equivalent alternate.
- F. Epoxy Coating: Ensure the epoxy coating applicator has Concrete Reinforcing Steel Institute (CRSI) fusion bonded epoxy coating applicator plant certification (AASHTO M-284).
- G. Pre-qualify all Coatings meeting Annex A-1 - "Pre-qualification of Organic Coatings for Steel Reinforcing Bars" (AASHTO M-284) of the material standard. Furnish a copy of the Pre-qualification Test Report to the city. Provide an 8-ounce sample of the coating material from each batch required by Engineer.
- H. The Engineer may witness coating processes for project work and obtain specimens from test bars for testing.
 - 1. Coat bars as shown on the plans.
 - 2. Maintain the coating thickness between 8 and 12 mils.
 - 3. Coat bars after bending, unless the fabricator can show that satisfactory results can be obtained by coating before bending.
 - 4. Reject any bent bars with visible cracks or damage in the coating.

2.02 ACCESSORY MATERIALS

- A. Tie Wire: Minimum 16 gauge coated wire (0.062 inch diameter, uncoated) or as accepted by the Engineer.
- B. Chairs, Bolsters, Bar Supports and Spacers: Epoxy-coated wire or plastic that are sized and shaped for strength and support of reinforcement during installation and placement of concrete.
- C. Precast concrete block bar supports shall meet the following:
 - 1. Use precast concrete block bar supports with minimum 28 day compressive strength of 2,500 psi.
 - 2. Three-inch thick supports with sides ranging from 4 to 6 inches with a minimum soil contact area of 24 square inches.
 - 3. Precast concrete block bar supports are only allowed when the concrete is

placed in contact with the soil and then only as the support for the bottom mat of bars.

2.03 FABRICATION

- A. Fabricate reinforcement in conformance with ACI 315, providing for the concrete cover specified in Section 03300.
- B. Locate reinforcing splices not indicated on plans at points of minimum stress. Indicate location of splices on shop drawings.
- C. Weld reinforcing bars in conformance with AWS D12.1.

PART 3 EXECUTION

3.01 PLACING

- A. All reinforcements shall be free of loose mill scale, loose or thick rust, dirt, paint, oil or grease and have a clean surface.
- B. Place all reinforcements in the design position shown on the plans and approved shop drawings and secure in position during the placing and consolidating of concrete. Wire bars together with No. 16 gauge wire with ties at all intersections except where spacing is less than 9 inches in each direction, in which case tie alternate intersections.
- C. Maintain the specified distance from the forms and between layers of reinforcement by means of prefabricated chairs, ties, hangers, or other approved devices. Placing and securing of reinforcement in each section of the work must be approved by the Engineer before any concrete is deposited in the section. Minimum spacing shall be as follows:
 - 1. 3" from reinforcement to earth
 - 2. 2" from reinforcement to concrete exposed to weather
 - 3. 2" from reinforcement to forms
- D. Do not tack weld reinforcing bars.
- E. Overlap sheets of metal mesh one square plus six inches to maintain a uniform strength. Securely fasten at the ends and edges and support to maintain clearances.
- F. Support reinforcing steel for formed floor slabs on chairs or bolsters. Size chairs or bolsters to position the steel in the specified location shown on the plans and with minimum coverages. Space chairs for supporting the top steel and bolsters for supporting the bottom steel not more than four feet on centers in each direction. Plastic coat that portion of the metal support in contact with the forms to prevent rust. Tie down deck steel to beams or forms at regular intervals of not more than five feet on centers along the beams to prevent movement of the steel during placing of the concrete.
- G. Support reinforcing steel for slabs on grade on metal chairs attached to a sand plate or use precast concrete block supports, as per Section 2.02 C above.
- H. Field Cutting: Saw or shear epoxy-coated bars that are specified to be cut in the field. Do not flame cut.
 - 1. Repair the sawed or sheared end using the specified patching or repair material.

3.02 SPLICING

- A. Furnish all reinforcement in the full lengths indicated on the plans unless otherwise permitted. Splicing of bars, except where shown on the plans, is not permitted without written approval from the Engineer. Stagger splices as far as possible.
- B. Unless otherwise shown on the plans, lap bars a minimum distance of thirty diameters to make the splice. In lapped splices, place the bars and wire in such a manner as to maintain the minimum distance to the surface of the concrete shown on the plans.

- C. Do not use lap splices on No. 14 and 18 bars. Comply with UDOT Section 508.3.4.7 for all mechanical butt splices.
- D. Weld reinforcing steel only if detailed on the plans or if authorization is made by the Engineer in writing. Weld in conformance to the current specification "Welding Reinforcing Steel AWS D 12.1 of the American Welding Society" and applicable special provisions. If welding, submit welder's certification to Engineer.
- E. Do not bend reinforcement after embedded in hardened concrete, unless permitted by Engineer.
- F. Do not permit reinforcement or other embedded metal items bonded to concrete, except dowels in floors bonded on only one side of joints, to extend continuously through any expansion joint.
- G. Do not heat or torch bars for bending or cutting.
- H. Construct joints where continuous reinforcing steel is cut (e.g. waterways, frogs, etc.). Drill and epoxy as specified by approved material manufacturer.

3.03 PLACING EMBEDDED ITEMS

- A. Place all sleeves, inserts, anchors, and embedded items required for adjoining work or for its support prior to concreting. Fill voids in embedded items temporarily with readily removable material to prevent entry of concrete.
- B. Give all contractors and subcontractors, whose work is related to concrete or supported by it, ample notice and opportunity to introduce and/or furnish embedded items before concrete placement.
- C. Veneer Anchors: To fit conditions, ASTM A 525, G90 galvanized.
 - 1. Dovetail Anchors: Hohmann and Barnard, Inc. or another supplier acceptable to the Engineer.
 - 2. Locate anchors at all brick locations 16 inches on center vertically and 24 inches horizontally or as shown on the plans.

END OF SECTION

SECTION 03250
CONCRETE CURING COMPOUND AND JOINT FILLERS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, and equipment as required for concrete curing, joint sealing, and joint filling.
- B. Perform all work and materials necessary for visually concealing expansion joints in concrete.

1.02 RELATED WORK AND REFERENCES

- A. Section 03100 - Concrete Formwork
- B. Section 03300 - Cast-In-Place Concrete
- C. AASHTO M 153 - Preformed sponge rubber and cork expansion joint fillers for concrete paving and structural construction.
- D. ASTM D 994 - Preformed Expansion
- E. ASTM D 1190 - Concrete Joint Sealer, Hot-Poured Elastic Type
- F. ASTM D 1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
- G. ASTM D 1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

PART 2 PRODUCTS

2.01 CONCRETE CURING COMPOUND

Comply with current UDOT Qualified Products Listing.

2.02 SILICON JOINT SEALER

- A. Supply silicone joint sealer made of low-modulus silicone specifically formulated to seal Portland Cement Concrete pavement joints, and meeting the test requirements of Table 2.02.
- B. Furnish silicone sealant in a one-part, non-acid curing formulation.

TABLE 2.02	
Tensile Stress: 150% maximum elongation, 7-day cure @ 77±3° F and 45-55% relative humidity (rh)	45 psi
Flow	0.3 inches maximum
Extrusion Rate	75-250 grams/min.
Specific Gravity	1.01 - 1.515
Durometer Hardness, shore A: cured 7 days @ 77±3° F and 45-55%, rh	10 - 25 (0° F)
Shelf Life	6 month min. From date of shipment from plant or point of manufacture.
Ozone and Ultraviolet (UV) Resistance	No chalking, cracking or bond loss after 5,000 hours.
Bond to concrete mortar concrete briquet air cured 14 days @ 77±3° F	50 psi minimum
Movement capability and adhesion. Magnitude of cycles movement shall be appropriate for sealant category, cure 7 days in air 77±3° F and then 7 days in water 77±3° F	+100% and -50% of joint width. No more than 6 sq in. (Adhesive or cohesive) failure in the 3 specimens combined after 10 cycles.

2.03 BACKER ROD

Provide backer rod used in sawed joints for Portland Cement concrete pavements that are closed-cell, polyethylene-foam rods and conform to the following requirements:

1. Diameter: Joint width + 1/8 in.
2. Density: 2.0 lb/cu. ft. as per ASTM D-1622
3. Tensile Strength: 25 psi as per ASTM D-1623
4. Absorption: 0.5% by volume as per ASTM C-509
5. Compression Reflection: 25% at 8 psi as per ASTM D-1621.

2.04 HOT-POURED ELASTOMERIC JOINT SEALANT (FOR PORTLAND CEMENT CONCRETE ADJACENT TO ASPHALT MATERIALS)

- A. Supply hot-poured elastomeric type sealant as specified in ASTM D-3406 and D-3583 for general requirements, physical properties, packing, marking, and sampling.
- B. Use concrete hot-poured elastic sealers as specified only when the joint sealant will come in contact with asphalt material (i.e. the longitudinal joint between the concrete pavement and bituminous shoulder.)

2.05 HOT-POURED ELASTOMERIC JOINT SEALANT (FOR PORTLAND CEMENT CONCRETE)

- A. Comply with current UDOT Qualified Products Listing, along with the physical requirements of ASTM D-2628.
- B. Use only as approved by Engineer.

2.06 PRE-MOLDED JOINT FILLERS

As specified in AASHTO M 153.

PART 3 EXECUTION

3.01 CONCRETE CURING COMPOUND

- A. Submit type of curing compound to be used to Engineer prior to application.
- B. Exposed surfaces shall be kept continuously moist until such time as curing compound can be applied.
- C. The curing compound shall be thoroughly mixed immediately before applying and shall be applied at a uniform rate as recommended by manufacturer.
- D. Curing compound shall not be applied to surfaces requiring bonding with subsequently placed concrete, as at construction joints, shear plates, reinforcing steel, and other embedded items.
- E. Surfaces subjected to heavy rainfall or running water within 3 hours after the compound has been applied, or surfaces damaged by subsequent construction operations during the curing period, shall be re-sprayed in the same manner as for the original application.
- F. Complete all patching or surface finishing before applying compound.

3.02 SILICON JOINT SEALER

- A. Meet the following physical requirements:
 - 1. Refer to the plan details.
 - 2. Ensure that the backer rod is compatible with the sealant and all components of the joint sealant system and meets the requirements of Section 2.03.
 - 3. Prevent any bond or adverse reaction from occurring between the backer rod material and the sealant.
- B. Do not place any material until the Engineer approves placement.
- C. Ensure the sealant is delivered in the manufacturer's original sealed container displaying the original manufacturer's name, lot number, expiration date of the shelf-life warranty, and the sealer trade name.
- D. Furnish a Certificate of Compliance verifying the test results, manufacturer's name, lot number, expiration date of the shelf-life warranty, sealer trade name, project destination, and representative sealant to the Engineer when the sealant is delivered to the job site.
- E. Use pre-qualified sealant from the current UDOT Qualified Product List.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 WORK INCLUDED

Furnish all labor, materials, and equipment required for the construction of:

1. Cast-in-place concrete structures including bridges, flatwork, floors, retaining walls, foundations, flood control structures and appurtenances, water vaults, and other concrete structural items of work.
2. Cast-in-place concrete and incidental items such as equipment pads, thrust blocks, pole bases, and other items of work requiring incidental concrete work.
3. Finish work required for all cast-in-place concrete work including finishing, brooming, rubbing, sealing, repairing, installing wearing surfaces, and all other work required to produce a finished project in accordance with the project plans and specifications.

1.02 RELATED WORK AND REFERENCES

- A. Section 03000 - Concrete Work
- B. Section 03050 - Concrete Curb, Gutter, Sidewalk, and Drive Approaches
- C. Section 03100 - Formwork
- D. Section 03200 - Concrete Reinforcement
- E. Section 03250 - Concrete Curing Compound
- F. Section 05000 - Material Testing
- G. ACI 301 - Specifications for Structural Concrete for Buildings
- H. ACI 305 - Hot weather; ACI 300 - Cold weather
- I. ACI 309 - Consolidation

1.03 ADDING WATER TO CONCRETE

Comply with requirements of Section 03000, 2.04D.

1.04 TIME LIMITATIONS

Comply with requirements of Section 03000, 2.04E.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

Comply with the requirements of Section 03000.

2.02 REINFORCING MATERIALS

Comply with the requirements of Section 03200.

2.02 CONCRETE CURING COMPOUND AND JOINT FILLERS. Comply with the requirements of Section 03250.

PART 3 EXECUTION

3.01 INSPECTION AND TESTING

- A. Obtain the approval of Engineer for all dimensions, steel location, condition of forms, and placing equipment at least four hours prior to placing any concrete.
- B. Test all concrete according to the requirements of Section 05000.

3.02 PREPARATION

- A. Clean inner surfaces of conveying equipment.
- B. Complete formwork, remove all snow, ice or water, secure reinforcement and expansion joint material, anchors, and embedded items, and have entire preparation approved by Engineer before starting concrete placement.
- C. Clean all form surfaces and embedded materials, and add approved form release agent.
- D. Moisten semi-porous subgrades to eliminate suction and seal porous subgrades in an approved manner.

3.03 CONVEYING

- A. Handle concrete from mixer to location of final placing as rapidly as practicable by methods which prevent segregation or loss of ingredients and assure that quality is maintained.
- B. Use only equipment conforming to ASTM C 94. Transport ready-mixed concrete in transit mixers or agitator trucks. Do not load trucks in excess of their rated mixing capacity, or 63 percent of the drum gross volume.
- C. Use metal or metal-lined chutes with slope between 1 vertical and 2 to 3 horizontal. Chutes over 20 feet long or not meeting slope requirements may be used provided they discharge into a hopper before distribution.
- D. Use only approved pumping equipment that is rated for the lift and capacity required for placement.
 - 1. Control pneumatic placement to prevent segregation.
 - 2. Loss of slump in pumping or pneumatic conveying equipment shall not exceed two inches and shall be within the tolerances for slump specified in Section 03000, 2.01, after pumping.
 - 3. Do not use aluminum alloy pipes.

3.04 PLACING CONCRETE

- A. Place concrete continuously or in layers of such thickness that no concrete is deposited on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within a section.
 - 1. If a section cannot be placed continuously, locate construction joints as indicated or as approved by the Engineer. If not indicated, locate construction joints as directed by Engineer.
 - 2. Place at such a rate that concrete which is being integrated with fresh concrete is still plastic. Limit placement interruptions to 45 minutes.
 - 3. Spread fresh concrete in horizontal layers with thickness not greater than what can be consolidated with vibrators and not exceeding 24 inches.
 - 4. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.
 - 5. Remove temporary spreaders in forms when concrete placing has reached an elevation rendering their service unnecessary.
 - 6. Temporary spreaders may remain embedded in the concrete only if made of metal or concrete and if prior approval has been obtained from the Engineer.

7. Do not allow the free-fall of concrete to exceed 10 feet for thin walls (maximum 10-inch thickness) or 5 feet for other types of construction without the use of a tremie or a flexible metal spout.
- B. Do not start placing supported elements until concrete previously placed in columns and walls is no longer plastic and has been in place at least two hours.
- C. Deposit concrete as nearly as practical to its final position to avoid segregation due to rehandling or flowing in the form a considerable distance.
- D. When placing concrete with a concrete pump, use a pump in good operating condition. Replace any pump that causes excessive or erratic loss of air entrainment.
 1. Use a pump that produces a continuous stream of concrete without air pockets.
 2. Do not add water to the concrete in the pump hopper.
 3. Do not allow pump vibrations to damage freshly placed concrete.
 4. Do not use concrete contaminated by the priming or cleaning of the pump.

3.05 CONSOLIDATION

- A. Consolidate by vibration so that concrete is thoroughly worked around reinforcement, embedded items, and into corners of forms to eliminate air or stone pockets, as per ACI 309.
- B. Use internal vibrators with minimum frequency of 8000 vibrations per minute, in compliance with ACI 309.
- C. Do not use vibrators to transport concrete laterally.
- D. Insert vibrators approximately 18 inches apart. Leave in long enough to consolidate concrete without segregation; generally from 5 to 15 seconds maximum. Insert vibrator through new lift into previous lift to ensure good bond between lifts within 15 minutes after it is deposited in the forms.
- E. Keep spare vibrator available during concrete operations.
- F. Where concrete is to have an as-cast or smooth-rubbed finish, bring a full surface of mortar against form by vibration process, supplemented if necessary by spading, to work coarse aggregate back from formed surface.
- G. Do not attach or allow vibrators to contact formwork or reinforcing steel. Do not vibrate forms.
- H. Do not allow vibrators to penetrate layers of concrete that have taken initial set.
- I. Use spades or wedge-shaped tampers to secure a smooth and even texture of the exposed surface.

3.06 CONSTRUCTION JOINTS

- A. Locate construction joints, if not indicated, so as to least impair strength of structure, subject to Engineer's approval.
 1. In general, locate near middle of the spans of slabs, beams, and girders unless a beam intersects a girder at this point. In this case, offset joint in girder a distance equal to twice the width of the beam.
 2. Locate joints in walls and columns at underside of floors, slabs, beams, or girders and at tops of footings or floor slabs.
 3. Place beams, girders, brackets, column capitals, haunches, drop panels, and slabs concurrently.
 4. Make joints perpendicular to main reinforcement.
- B. Continue reinforcement across joints.

1. Provide keys and inclined dowels as directed by Engineer.
 2. Provide longitudinal keys at least 1-1/2 inches deep in all joints in walls and between walls and slabs or footings.
- C. Clean concrete surface at joints.
- D. Remove all laitance prior to placing adjoining concrete.
- E. When required, obtain concrete bond conforming to ACI 301-16,6.1.

3.07 PLACING SLABS

- A. Preparation of Subgrade for Slabs on Grade:
1. Keep subgrade well drained and of adequate and uniform loadbearing nature. Maintain in-place density of subgrade soils at least to minimum indicated.
 2. Keep subgrade free of frost.
 3. If temperature where concrete is to be placed is below freezing, enclose, heat, and maintain temperature above 50 degrees F. long enough to remove all frost from subgrade.
- B. Set edge forms and intermediate screed strips accurately to produce designated elevations and contours.
1. Make sufficiently strong to support vibrating or roller pipe screeds, if finish specified requires their use.
 2. Align concrete surfaces to contours of screed strips by use of strike-off templates or approved compacting type screeds.
 3. When formwork is cambered, set screeds to maintain proper concrete thicknesses.
- C. Coordinate Mixing and Placing with Finishing:
1. Do not place concrete on subgrade or forms more rapidly than it can be spread on surface.
 2. Perform these operations before bleeding water has an opportunity to collect on surface.
 3. Size finishing crews so as to obtain optimum results considering concrete temperature and atmospheric conditions.
 4. Utilize approved chemical surface retarders when required to facilitate proper finishing.
- D. Locate Joints in Slabs as Indicated:
1. If saw-cut joints in slabs on grade are required or permitted, time cutting to eliminate raveling during sawing and before shrinkage cracks develop.
 2. Cut as soon as concrete has hardened sufficiently to prevent aggregates from being dislodged by saw.
 3. Complete before shrinkage stresses become sufficient to produce cracking.
- E. Thoroughly Consolidate Concrete in Slabs:
1. Use internal vibration in beams and girders of framed slabs and along bulkheads of slabs on grade.
 2. Obtain consolidation of slabs with vibrating screeds, roller pipe screeds, internal vibrators, or other approved means.

Comply with Section 03000, 3.04 - 3.05, and Section 03250.

3.09 REMOVAL OF FORMS

Comply with Section 03100.

3.10 FINISHING

- A. After removal of forms, repair and finish concrete surfaces as specified in 3.11 through 3.17 below.
- B. When finishing is required to match sample, have sample approved prior to proceeding.

3.11 PATCHING

- A. Repair surface defects immediately after form removal.
- B. Fill and finish tie holes as specified.
- C. Repair defective areas.
 - 1. Remove honeycomb and defective concrete down to sound concrete.
 - 2. Make edges perpendicular to surface or slightly undercut.
 - 3. Feather edges are not permitted.
 - 4. Material to be used for repair is to be approved by Engineer .
 - a. Prepare bonding grout of approximately 1 part cement to 1 part fine sand passing a No. 30 sieve.
 - b. Bonding, Primer Epoxy as approved by Engineer.
 - 5. Mix as directed by manufacturer.

3.12 AS-CAST FORMED FINISHES

- A. Rough: Patch defects chip or rub off fins exceeding 1/4 inch in height.
- B. Smooth: Patch tie holes and defects and remove fins completely.
 - 1. When surface texture is impaired and form joints misaligned by more than 1/8 inch, grind, bush hammer, or correct affected concrete as directed by Engineer.
 - 2. Slurry grout areas evidencing minor mortar leakage to match adjacent concrete.
 - 3. Repair major mortar leakage as a defective area.
 - 4. When, in the opinion of the Engineer, workmanship is less than acceptable standard, provide one of rubbed finishes at no additional cost.

3.13 RUBBED FINISHES

- A. Smooth Rubbed: Remove forms and perform necessary patching as soon after placement as possible.
 - 1. Finish newly hardened concrete no later than day following form removal.
 - 2. Wet surfaces and rub with Carborundum brick or other abrasive until uniform color and texture are produced.
 - 3. No cement grout to be used other than cement paste drawn from concrete by rubbing process.
- B. Grout Cleaned: Undertake no cleaning operations until all contiguous surfaces are completed and accessible.

1. Mix one part Portland cement and 1-1/2 parts fine sand with sufficient water to produce grout having consistency of thick paint.
 2. Mix white and gray Portland cement to match color of surrounding concrete.
 3. Wet surface of concrete sufficiently to prevent absorption of water from grout.
 4. Apply grout uniformly.
 5. Immediately after grouting, scrub surface vigorously with cork float or stone to coat surface and fill voids.
 6. While grout is still plastic, remove excess grout by working surface with rubber float or sack.
 7. After surface whitens from drying, rub vigorously with clean burlap.
 8. Keep damp for at least 36 hours after final rubbing.
- D. Cork Floated: Remove forms within two to three days of placement where possible.
1. Remove ties.
 2. Remove all burrs and fins.
 3. Mix one part Portland Cement and one part fine sand with sufficient water to produce a stiff mortar.
 4. Dampen wall surface.
 5. Apply mortar with firm rubber float or with trowel, filling all surface voids.
 6. Compress mortar into voids.
 7. If mortar surface dries too rapidly to permit proper compaction and finishing, apply a small amount of water with fog sprayer.
 8. Produce final texture with cork float using a swirling motion.

3.14 UNSPECIFIED FINISH

If finish is not designated, use following finishes as applicable:

1. Unpainted concrete surfaces not exposed to public view: Rough as-cast form finish.
2. Unpainted concrete surfaces exposed to public view: Smooth as-cast form finish.
3. Concrete surfaces to receive paint or plaster: Grout cleaned, rubbed finish.

3.15 UNFORMED SURFACES

- A. After concrete is placed, strike smooth tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces.
- B. Float to texture which is consistent with formed surfaces.
- C. Continue final treatment on formed surfaces uniformly across unformed surfaces.

3.16 FLATWORK FINISHES

- A. Broom Finish: Immediately after concrete has been floated, apply coarse transverse, scored texture by drawing broom across surface.
- B. Floated Finish: After concrete has been placed, consolidated, struck-off and leveled, do not work further until ready for floating.

1. Begin floating when water sheen has disappeared and surface has stiffness sufficient to permit operation.
2. During or after first floating, check entire surface with a 10 foot straightedge applied at two or more different angles.
3. Cut down high spots and fill low spots to the required tolerance.
4. Refloat slab immediately to a uniform, sandy texture.

3.17 UNSPECIFIED FLATWORK FINISH

When type of finish is not indicated, use broom finish.

END OF SECTION

SECTION 03350
CATCH BASINS AND INLETS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Furnish all labor, materials and equipment as required to construct catch basins and inlets as shown on the standard drawings and plans and as directed by the Engineer.
- B. Provide all excavation, backfill, compaction, connection to new or existing piping and all related work required to construct a finished structure.

1.02 RELATED WORK AND REFERENCES

- A. Section 02220 - Excavation
- B. Section 02230 - Materials
- C. Section 02240 - Backfill, Compaction, and Embankment
- D. Section 03000 - Concrete Work
- E. Section 03100 - Concrete Formwork
- F. Section 03200 - Concrete Reinforcement
- G. Section 03300 - Cast-In-Place Concrete
- H. Section 03450 - Structural Precast Concrete
- I. Manual on Uniform Traffic Control Devices (MUTCD)
- J. Salt Lake County Standard Details

PART 2 EXECUTION

2.01 SHOP DRAWINGS AND PRODUCT DATA

Refer to Section 03450, 1.06.

2.02 PROTECTION

- A. Protect catch basins and inlets from runoff water by diking, pumping, or as required to protect freshly placed concrete or grout.
- B. Provide a means of keeping water from causing any damage.
- C. Barricade work in accordance with current MUTCD.

PART 3 EXECUTION

3.01 CONSTRUCTION

- A. Standard catch basins and inlets may be constructed of precast units, or cast-in-place concrete, all in compliance with the Standard Details and Construction Specifications.
- B. Construct catch basins and inlets to the dimensions and elevations shown on the plans and Standard Details or as directed by the Engineer.
- C. Secure grate seats in place prior to placing concrete.
- D. Make construction joints in concrete only as allowed on the plans or as approved by the Engineer.

- E. Construct inlets or catch basins with all connecting piping and appurtenances in their final position. Cut all piping flush with the interior surface of all catch basins and inlets and grout all cut pipe surfaces to provide a smooth transition inlet into the pipe.
- F. Keep all concrete and debris from entering connecting pipes. After catch basins or inlets are complete, remove all gravel, concrete, and debris.
- G. Set the grate frames to the elevation shown on Standard Details.
- H. Backfill around catch basins shall be as per section 02240 - 5.01.
- I. All openings in the walls of catch basins constructed with precast section for the insertion of pipe connections and outlet trap castings shall, after pipe or castings have been placed to their final position, be grouted tight in place using non-shrinking mortar in a workmanlike manner to present an inside and outside surface conforming to the Standard Details.
- J. At the conclusion of work, all formwork and miscellaneous equipment shall be removed from site.
- K. Include sand traps as specified in plans.

END OF SECTION

SECTION 03400
STORM DRAIN MANHOLES

PART 1 GENERAL

1.01 WORK INCLUDED

Provide all labor, materials, and equipment as required to construct cast-in-place or precast manholes, including but not limited to, excavation, backfill, formwork, concrete work, precast barrel sections and cone section, cast iron frame and cover, and all incidental work and appurtenances.

1.02 RELATED WORK AND REFERENCES

- A. Section 02220 - Excavation
- B. Section 02240 - Backfill, Compaction, and Embankment
- C. Section 02433 - Pipe Installation
- D. Section 03000 - Concrete Work
- E. Section 03100 - Concrete Formwork
- F. Section 03200 - Concrete Reinforcement
- G. Section 03300 - Cast-In-Place Concrete
- H. Section 03450 - Structural Precast Concrete
- I. ASTM C 478 - Precast Reinforced Concrete Manhole Sections
- J. Salt Lake County Standard Drawings
- K. Contact appropriate sewer district for specific requirements.

PART 2 PRODUCTS

2.01 PRECAST MANHOLE SECTIONS

- A. Use 60-inch inside diameter manholes unless otherwise shown on the plans.
- B. Conform to ASTM C 478.
- C. Use concentric cones of manufacturer's standard dimensions.
- D. Refer to Section 03450 for specific construction requirements.

2.02 FRAME AND COVER

- A. All castings to be planed or ground where necessary to ensure complete contact between ring and cover.
- B. Use covers which have the appropriate word description, for the type of manhole access, in two inch raised letters.
- C. Repair of defects in castings by welding or other methods will not be permitted.

2.03 EXTENSION RINGS (GRADE RINGS)

Use concrete extension rings as per Section 02438.

PART 3 EXECUTION

3.01 DEWATERING

- A. Keep pipe trenches free from water during pipe installation by a method acceptable to the Engineer. Contractor is responsible for damage of any nature resulting from the dewatering operations, notwithstanding approval of the method by the Engineer.
- B. Dewatering of the trench is considered incidental to the construction. Include all associated costs for trench dewatering in the lump sum contract prices and the unit rates to add or delete quantities.

3.02 CONCRETE BASES

- A. Level area under base to within ½ inch of true grade in undisturbed natural soils and compact to 96 percent maximum density as per method in Section 02240, 3.02, or if site conditions require, over excavate and place on one (1) foot of granular borrow as per Section 02230, compacted to 96 percent.
- B. Cast-in-place concrete base for manhole so that the first section of the precast manhole section will have uniform bearing throughout the full circumference of the section wall, extending at least three inches into the concrete base forming a completely water-tight joint. Construct the invert to ensure smooth flow.
- C. Precast concrete manhole bases may be used if prior approval is obtained from the Engineer.
- D. Provide sand traps as called for in plans.

3.03 BARREL SECTIONS

- A. Place precast manhole sections vertical and true to line and grade as established by the Engineer.
- B. Construct manholes so they are water-tight both in the floor and for the full height of the walls. Use only manufacturer approved mastic.
- C. Attach pipe to precast manholes with a water-tight grout, as per Section 03350, 3.01.I.

3.04 HEIGHT OF MANHOLE COVERS

Comply with requirements of Section 02438, 3.03.

3.05 MANHOLE COLLARS

Collar manholes as required in Section 02438 and as detailed in Standard Detail SW-01.

END OF SECTION

SECTION 03450
STRUCTURAL PRECAST CONCRETE

PART 1 GENERAL

1.01 WORK INCLUDED

Furnish all labor, material, and equipment required to furnish and install precast structural concrete units, complete with required connecting and supporting devices.

1.02 RELATED WORK AND REFERENCES

- A. Section 03000 - Concrete Work
- B. Section 03200 - Concrete Reinforcement
- C. Section 03300 - Cast-In-Place Concrete

1.03 MANUFACTURER AND ERECTOR QUALIFICATIONS

- A. Manufacture, transportation, and installation only by company specializing in providing precast products and services normally associated with precast concrete construction, or as approved by Engineer.
- B. Welders: AWS D1.1 qualified. Submit welder certification to Engineer.

1.04 DESIGN CRITERIA

- A. Design precast structural concrete units in accordance with ACI 318 and AASHTO H-20 loading.
- B. Design precast structural concrete units under direct supervision of a Professional Engineer registered in Utah who is fully experienced in design of precast concrete structural units. Design to be stamped by a Professional Engineer registered in Utah.
- C. Design precast structural concrete units to support required live and dead loads.
- D. Design component connections to provide for foundation settlement and building movement. Provide adjustment connection to accommodate misalignment of structure.
- E. Design precast concrete structural system to accommodate, by means of expansion joints, movement in structure and between cladding elements and structure without permanent distortion, damage to components, racking of joint connections, or breakage of seals.
- F. Submit to Engineer for review any deviation in design or dimensions required.

1.05 TESTING

- A. Test concrete according to Section 05000.
- B. Submit test results to Engineer for review and approval.

1.06 SHOP DRAWINGS

- A. Submit shop drawing if required by Engineer. Do not proceed with fabrication until required shop drawings have been approved by Engineer.
- B. Indicate unit locations, unit identification marks, fabrication details, reinforcement, connection details, pertinent dimensions, and erection support points. Unit identification marks to appear on all manufactured units.
- C. Prepare shop drawings under seal of Professional Engineer registered in State of Utah.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Handle precast units in positions consistent with their shape and design. Do lifting and supporting only from support points indicated on shop drawings.
- B. Embedded Lifting or Handling Devices: Capable of supporting units in positions anticipated during manufacture, storage, transportation, and erection.
- C. Block and laterally brace units while stored at manufacturer's location. Provide lateral bracing that is sufficient to prevent bowing and warping that is clean, non-staining, and will not prevent uniform curing of exposed surfaces.
- D. Provide edges of units with adequate protection to prevent staining, chipping, or spalling of concrete.
- E. Unless otherwise approved in writing by the Engineer, do not deliver units to job site until they are required for installation.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials: ACI 318, ASTM specifications.
- B. Use concrete as specified in Section 03000.
- C. Use 60 grade reinforcing for all precast units.

2.02 ACCESSORIES

- A. Connecting and Supporting Devices: ASTM A 36.
- B. Bolts, nuts, and washers: High-strength steel type recommended for structural steel joints, quenched and tempered alloy steel type, ASTM A 325.

2.03 FABRICATION

- A. Maintain plant records and quality control program during production of structural precast concrete. Make records available to Engineer.
- B. Use molds which are rigid and constructed of material that will result in uniform finished products.
- C. Deposit and vibrate concrete to ensure proper consolidation, elimination of unintentional cold joints, and to minimize entrapped air on surfaces.
- D. Fabricate required connecting devices, plates, angles, items fit to steel framing members, insets, bolts, and accessories.
- E. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in-place items are sufficiently embedded, anchored, and properly located.
- F. Ensure finished surfaces of precast structural units are uniform and match approved sample panel.
- G. Cure units under near identical conditions to develop specified concrete quality, and minimize appearance blemishes such as non-uniformity, staining, or surface cracking.

2.04 DESIGN DEVIATIONS

- A. Deviations from exact required cross-section will be permitted only with the Engineer's approval. Such deviations may also include connections, inserts, etc. Provide installation equivalent to basic intent without incurring additional cost to City.
- B. Manufacturer's Proposed Design: Supported by complete design calculations and drawings. When requested, submit design calculations for review bearing seal and signature of a Professional Engineer registered in the State of Utah.

2.05 OPENING

Provide required openings, six inches or larger in size. Smaller size may be field constructed by coring or sawing in the field.

2.06 STANDARD FINISHES

All precast finishes will conform to Section 03300, 3.12B.

2.07 ALLOWABLE TOLERANCES

- A. Length: Plus or minus 3/4 inch, or plus or minus 1/8 inch per 10 feet of length, whichever is greater, or as shown on the plans.
- B. Cross-Sectional Dimensions: Less than 24 inches, plus or minus 3/8 inch; 24 inches to 36 inches, plus or minus 1/2 inch; over 36 inches, plus or minus 5/8 inch, or as shown on the plans.
- C. Flange Thickness: Thin section plus or minus 1/4 inch.
- D. Position of Anchors and Inserts: Plus or minus 1 inch of center line location shown on drawings.
- E. Horizontal Alignment: 1/2 inch, or 1/8 inch per 10 foot length, whichever is greater. Maximum of 1 inch gap between 2 adjacent members due to sweep, or as shown on the plans.
- F. End Squareness: 1/2 inch maximum.
- G. Blockouts: 1 inch of centerline location shown on drawings.
- H. Camber Deviation from Design: Plus or minus 3/16 inch per 10 feet length.
- I. Camber Differential Between Adjacent Members, After Installation: 1/4 inch per 10 feet length, 3/4 inch maximum.

2.08 PATCHING

Minor Patching in Plant: Acceptable providing structural adequacy and appearance of units is not impaired.

PART 3 EXECUTION

3.01 ERECTION

- A. Provide for erection procedure, temporary bracing, and induced loads during erection. Maintain temporary bracing in place until final support is provided.
- B. Provide necessary hoisting equipment.
- C. Erect units without damage to shape or finish. Replace or repair damaged units.
- D. Erect units level, plumb, square, and true within allowable tolerances.
- E. Level out variations between adjacent units by jacking, loading, or other feasible means.
- F. Securely fasten units in place.

3.02 REPAIR

Repair or replace damaged units. Repair of damaged units is acceptable if structural integrity or appearance is not impaired.

3.03 CLEANING

Clean weld marks or other marks, debris, or dirt from exposed surfaces of units.

END OF SECTION

SECTION 03500
PORTLAND CEMENT CONCRETE PAVING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Placing concrete base courses and surface courses.
- B. Concrete product is not specified in this Section. Refer to Section 03000.

1.02 RELATED WORK AND REFERENCES

- A. Section 03000 - Concrete Work
- B. Section 03100 - Concrete Formwork
- C. Section 03200 - Concrete Reinforcement
- D. Section 03250 - Concrete Curing Compound and Joint Fillers
- E. Section 05000 - Material Testing
- F. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
- G. ASTM C 78 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
- H. ASTM C 136 - Standard Method for Sieve Analysis of Fine and Course Aggregates
- I. ASTM C 150 - Standard Specifications for Portland Cement
- J. ASTM D 5249 - Standard Specifications for Backer Material for Use with Cold and Hot Applied Sealants in Portland Cement and Asphalt Joints

PART 2 PRODUCTS

2.01 CONCRETE

- A. Class AA(AE) per Section 03000.
- B. Slump per mix design

2.02 MISCELLANEOUS MATERIALS

- A. Reinforcement: Section 03200.
- B. Hook Bolts: ASTM A 307, Grade A nuts and bolts, internally and externally threaded.
- C. Expansion Joint Filler: Per Section 03250.
- D. Contraction Joint Filler (Backer Rod): Per Section 03250.
- E. Contraction Joint Sealant: Per Section 03250.
- F. Curing Compound: Per Section 03250.
- G. Bond Breaker: Wax based compound.

PART 3 EXECUTION

3.01 PREPARATION

- A. General:
 - 1. Remove sand, leaves and other objectionable materials prior to placing concrete pavement.
 - 2. Notify Engineer 48-hours prior to commencement of concreting operations.
- B. Trees, Plants, Ground Cover: Protect trees, plants and other ground cover from damage per Section 01620
- C. Traffic Control: Provide traffic control, flagging, temporary signing, barricades and pilot car operations as required.
- D. Base Course:
 - 1. Verify base course is placed to grade and compacted.
 - 2. If indicated, apply prime coat.
- E. Cold Joints: Apply concrete bonding compound to face of existing concrete.

3.02 FORM CONSTRUCTION

Follow Section 03100 requirements.

3.03 REINFORCEMENT PLACEMENT

- A. Follow Section 03200 requirements.
- B. Interrupt reinforcement at expansion joints.
- C. Use load transfer bars on longitudinal construction and transverse construction joints.
- D. Use smooth dowel in expansion joints.
- E. Keep load transfer bars and dowels in vertical center of concrete and perpendicular to the joint during concrete placement.
- F. Position mats on bar chair supports and properly tie before any concrete placement. Keep mats clean, free from rust, flat, and free of distortion. Straighten bends, kinks, and other irregularities or replace units before concrete placement. Provide a minimum of 2-inch overlap to adjacent mats.

3.04 JOINTS

Use APWA Plan Number 261 in conjunction with the following.

- A. General:
 - 1. Review joint layout with Engineer. Note all transverse pavement joints are to be aligned with the curb & gutter joints.
 - 2. All transverse contraction joints shall be Type E per Plan No. 261. Joint width shall be 1/8 inch, saw cut at T/3, with no cap on dowels.
 - 3. All transverse construction joints shall be Type E per Plan No. 261.
 - 4. All longitudinal construction and contraction joints shall be Type C per Plan No. 261.
 - a. Joints shall be constructed a minimum of 18 inches from street fixture.
 - b. Where full block-out panels are placed around street fixtures (manholes, clean-outs, water valves, etc.), the perimeter construction joints shall be a Type E per Plan No. 261.
 - c. Where block-out panels abut storm drain clean-out boxes, vaults, or other surface structures, the perimeter construction joint shall be a Type G per Plan No. 261.
 - d. Manholes, water valves and similar structures shall be placed monolithic with block-out panel.
 - e. Where partial block-out panels are authorized by the Engineer, the perimeter construction joint shall be a Type F per Plan No. 261.

- B. Construction Joint (contact joints made by placing concrete against cured concrete):
 - 1. The contact joint between separately laid lanes cannot deviate from a true line by more than 1/4 inch in any direction at any point.
 - 2. Tie both sides of longitudinal and transverse construction joints together with tie bars. Before placing concrete in adjoining slab, straighten tie bars to 0.1 feet of straight position.
 - 3. Do not cause edge slump when placing tie bars or by over working edge of slab.
- C. Contraction Joints (crack control joints):
 - 1. Joint spacing measured in feet = twice the slab thickness measured in inches or a maximum of 15 feet.
 - 2. Joint depth = T/3 per APWA Plan 261, detail A. Single cut all transverse and longitudinal joints 1/8 inch wide.
 - 3. Use of mechanical control joint void former in lieu of saw cutting or tooling is acceptable.
 - 4. Longitudinal joints are to be same dimension as transverse joints.
 - 5. Make transverse joints across full width of pavement and meet curb and gutter joints.
 - 6. Leave forms in place until paving operations are resumed on the other side of the joint.
- D. Volunteer Crack Joints: Volunteer cracks are not acceptable.
- E. Expansion Joints:
 - 1. If a deformed rebar is used in an expansion joint, provide sleeve for movement.
 - 2. Secure fillers to prevent movement. When butted together, do not leave voids or gaps between filler units.
 - 3. Set joint fillers full depth if no joint sealant is specified.
 - 4. Recess joint fillers if backer rods and joint sealant are specified or provide a plastic cap.
- F. Joint Sealing: Follow Section 03250 requirements.
- G. Final sawing and sealing must be completed prior to opening roadway to any traffic.

3.05 CONCRETE PLACEMENT

- A. Section 03000.
- B. Any delay in excess of 15 minutes from placing to start of finishing operations is cause for stopping work to correct the difficulties.
- B. Do not place concrete until concrete sub base and surface course forms have been checked for line and grade. Moisten sub base if required to provide a uniform dampened condition at time of placement. Do not place concrete around manholes or other structures until they are at required finished elevation and cross slope.
- B. Prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocation of reinforcement, dowels, and joint devices.
- B. Do not place concrete in a longitudinal section until test specimens from the adjacent lane have attained an ASTM C 78 flexural strength of 450 psi.
- B. Deposit and spread concrete in a continuous operation between transverse joints. If interrupted for more than ½ hour, place a construction joint.
- B. Place the concrete to the full width of the pavement in a single construction operation unless indicated otherwise.

3.06 FINISHING

- A. Follow Section 03300 requirements.
- B. Any delay in excess of 30 minutes for completing the finishing operation is cause for stopping concrete placing to correct the difficulty.
- C. After striking off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.
- D. After floating, test slab for trueness with a straight edge. Distribute concrete as required to remove surface irregularities. Refloat repaired areas to provide a continuous smooth finish.
- E. Round edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool. Eliminate tool marks.
- F. After completion of floating when excess moisture or surface sheen has disappeared, apply a transverse tinning finish unless indicated otherwise.
- G. Do not remove forms for at least 24 hours after concrete has been placed. After form removal, clean ends of joints and patch any minor honeycombed areas. Remove and replace areas or sections with major defects.

3.07 PROFILE TOLERANCES

The maximum vertical distance from the pavement surface to a straight edge line is:

- 1. 1/8 inch in 10 feet parallel to centerline.
- 2. 1/4 inch in 10 feet perpendicular to centerline except at cross section grade breaks.
- 3. Profile shall be measured per Section 03510.

3.08 CURING

- A. Follow Section 03000 requirements.
- B. Comply with current UDOT Qualified Products Listing.

3.09 PROTECTION AND REPAIRS

- A. After concrete cure, plane off surface distortions that exceed specified profile tolerances. Water proof planed surfaces with a APWA Section 071909 water repellant.
- B. Do not allow any steel wheel rollers or steel wheel vehicles on the concrete pavement.
- C. If construction traffic is permitted, keep pavement clean. Remove surface stains and spillage of materials as they occur.
- D. Drill test cores when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in pavement areas with Portland cement concrete bonded to pavement with epoxy adhesive.
- E. Remove saw cutting dust immediately.
- F. Damaged panels will be replaced in their entirety. There will be no partial panel repairs (ie. Panels cut in the course of future work will be completely removed and replaced). See Standard Detail CP-01.

END OF SECTION

SECTION 03510
PROFILOGRAPH AND SMOOTHNESS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Materials and procedures for smoothness testing of Portland Cement Concrete Pavement (PCCP).
- B. Requirements for 25-foot wheel base, California type profilograph with electronic data recording, storing, data reduction, and printing capabilities.

1.02 ACCEPTANCE

- A. Test as work progresses and accept in lots to the number of square yards placed each day.
- B. Thin Lifts:
 - 1. Evaluate and accept the finished surface in 0.10 mile sections.
 - 2. Begin the initial section at the start of the project. Lay out subsequent sections consecutively to the end of the project.
 - 3. If the final section is less than 0.10 mile, add the section to the previous full 0.10 mile section. Otherwise, evaluate the section individually.

PART 2 PRODUCTS

2.01 FRAME

- A. Construction:
 - 1. All welded of light-weight aluminum tubing in three separate units of the same dimensions in width and within six (6) inches in length of each other.
 - 2. Design using reinforced truss.
- B. Length:
 - 1. Effective wheel base of the frame assembly shall be 25 feet.
 - 2. Overall length with multiple wheel assemblies attached shall not exceed 35 feet.
- C. Frame Connections:
 - 1. Indexed with steel location pins or dowels to prevent misalignment of frame assembly.
 - 2. Secured with quick acting clamps rated at a minimum of 800 pounds each.
- D. Parts: Each of the three frame units manufactured shall allow for interchangeable replacement of individual units.

2.02 WHEEL SUPPORT ASSEMBLIES

- A. Tubing: All welded, light-weight square aluminum.
- B. Connections: All connection points between wheel assemblies and frame sections shall be secured with quick-acting clamps.
- C. Support Wheels: Cast aluminum hubs with ball bearing supported steel axles and cushion rubber tires. Caster wheel assemblies shall be ball bearing supported.
- D. Front Wheels: Steerable from the center of the machine.
- E. Rear Wheels: Quick setting manual adjustment to allow for short radius turning, moving laterally, and for trimming to avoid crabbing on superelevations.

2.03 RECORDING WHEEL

Shall be light weight, 24 inch to 26 inch nominal diameter, and heavy duty spokes.

- A. Tire: Pneumatic tube type with non-aggressive tread design.
- B. Frame: All welded of light-weight square aluminum tubing. Frame pivot points and rotating shafts supported by scaled ball bearings.

2.04 GENERAL MECHANICAL

- A. All exposed steel components anodized, nickel plated, or zinc plated for corrosion protections.
- B. Interchangeable parts.
- C. Capable of being broken down in segments that can fit into the back of a standard pickup truck or van for ease of transport.
- D. Constructed to allow complete assembly in less than 15 minutes without tools.

2.05 AC POWER GENERATING UNIT

- A. Self-contained, capable of delivering 120 VAC at 60 Hz.
- B. Mount on the frame with appropriate vibration and shock control hardware.

2.06 MICROCOMPUTER

- A. Control the system by a dedicated on-board microcomputer.
- B. The microcomputer components replaceable and interchangeable with like items from the manufacturer's stock to facilitate controller repairs and provide the following minimum operation characteristics:
 - 1. Processor:
 - a. Minimum 16 bit microprocessor capable of running at a nominal 8 MHz processing speed.
 - b. On-board memory sufficient to store Profile Index (PI) and bump Discrimination software.
 - c. RAM memory sufficient to input control parameters and process project documentation variables at the test site.
 - 2. Displacement Transducer Interface:
 - a. Contains an analog to digital converter compatible with the operating characteristics of the microprocessor.
 - b. Include signal conditioning for analog filtering and scaling.
 - c. Overall resolution for displacement transducer less than or equal to 0.004 inches.
 - 3. Odometer Transducer Interface: Provides digital logic to encode positive or negative signals to microprocessor.
 - 4. Clock:
 - a. Provides time and calendar functions to microprocessor unit automatically.
 - b. Independent battery power required to avoid documentation errors and input data losses caused by on-board power shut downs.

2.07 TRANSDUCERS

Rated to withstand shock, vibration, dust and extremes of humidity. Operational from -30 degrees C to 100 degrees C.

- A. Vertical Displacement Transducer: Resolution of 0.01 inches.
- B. Odometer: Horizontal resolution of 0.39 inches and operational in either an incrementing or decrementing mode.
- C. Temperature Transducer: Accurate to +/- 1 degree C.

2.08 PRINTER/PLOTTER

- A. Compatible with and provide suitable interfaces with the microprocessor.
- B. Data acceptance (baud rate) and buffer storage capacity: Adequate to fully register, plot, and accept data from a 4 mph operational run without excessive wait states.
- C. Dot matrix mechanism (if applicable): Print bar resolution of 100 dots per inch minimum

with a row resolution of 200 rows per inch minimum.

2.09 OPERATOR CONTROL PANEL

- A. Located within easy access of the operator and in a location on the profilograph that does not hinder other operational functions or line of sight to testing path.
- B. Control panel with a digital display, data input key board, observable indicators, video/screen and operator actuated control switch.
- C. Parameters entered, displayed, and printed as follows (all numeric):
 - 1. Time
 - 2. Date
 - 3. Region, route and pavement
 - 4. Pass number
 - 5. Beginning Station
 - 6. Ending Station
 - 7. Odometer
 - 8. Blanking band width
 - 9. Bump height
 - 10. Bump width
 - 11. Event marker

2.10 REPORTING REQUIREMENTS

- A. Determine profile Index, documentation reports, outputs, or example as specified. UDOT Materials Manual 8-995.
- B. Set preprogrammed or operator entered scaling or sensitivity factors at a sensitivity level that correlates with City profilographs.
- C. Include the following documentation supplied with the Profilograph system:
 - 1. Operator's Manual
 - 2. Wiring Diagram
 - 3. Industry standard number or name and model numbers for complete subsystems.

PART 3 EXECUTION

3.01 TESTING AND CORRECTING PAVEMENT

- A. Provide rotating amber lights or strobe light so the device and operator are highly visible from front and rear.
- B. Appropriately certify operators. Engineer will verify certification.
- C. The Engineer will witness all profile testing for acceptance.
- D. Run a Profile Index within two working days of placement, starting 100 feet before the beginning of the day's placement and ending 50 feet before the end of the day's placement.
 - 1. A day's production for categories 1, 2 and 3 is the length between intersections.
 - 2. A day's production for categories 4 and 5 is the length between intersections.
 - 3. Group quantities smaller than 4000 square yards with the subsequent day's production.
 - 4. Profile Index is defined as the average of the two profiles taken as described.
- E. Take two profiles for each traffic lane three (3) feet from each edge of the traffic lane.
 - 1. Evaluate in 0.1 mile consecutive sections.
 - 2. Use a blanking band of 0.2 inches.
 - 3. Match stationing to pavement stations.
- F. Do not include side street intersections and returns in the Profile Index.
- G. Do not include bridges in the Profile Index. Start and end the profile index 15 feet from each bridge approach or existing pavement that abuts new pavement, running in the same direction as the pavement.

- H. Correct all deviations in pavement exceeding the limits specified below.
 - 1. Maximum deviations:
 - a. Maximum Profile Deviation of 0.3 inches per 25 feet.
 - b. Maximum Section Profile Index of fourteen (14) inches per mile.
 - 2. Requirements:
 - a. Remove all high points with an approved grinding device or a device consisting of multiple blades.
 - b. Re-profile the areas requiring corrective action for correction verification.
 - c. Skid resistance of final surface must be equal to or better than adjacent sections not requiring corrective work.
 - d. Re-saw to proper depth, clean, and reseal all transverse joints in the ground area.
 - e. Taper ground areas from the lane/shoulder line into the shoulder area at the rate of not greater than 0.25 inches per foot.
- I. Traffic control for grinding or sawing is at no additional cost to the City.
- J. Conduct a final profilograph run from start to end of the project including all structures for both directions of travel after all corrective work is completed. Profilographs become the property of the City and are used for informational purposes.
- K. Provide the profiles to the Engineer at the completion of each record testing run.

END OF SECTION